The Glass Industry
REG. U. S. PAT. OFF.

Vol. 14 JULY, 1933 No. 7

Pressure and Suction Fans

By JOHN W. ROMIG*

PROBABLY the most useful auxiliary in glass manufacturing and glass manufacturing processes is the group of equipment included under the heading, FANS AND BLOWERS. They remove waste products, shavings, dust, waste gases, poisonous fumes and other undesirable elements. They ventilate for summer and distribute heat for winter comfort. They furnish volume air for combustion, for cooling processes, for drying, and for many other specialized applications. Handling of material is also within the scope of work done by this specialized group of apparatus. Even though the application of fans and blowers is quite general, information dealing with various types and their application is rather scattered.

Blowers are usually considered as that group of fans that operate at higher pressures. The distinction between a fan and a blower is more or less undefined and for all practical purposes a fan may be called a blower and vice-versa without encountering vigorous disapproval on the part of blower and fan experts, salesmen and engineers.

Rather than discuss fans and then blowers and attempt to tell the difference, all fans and blowers will be considered as fans. Fans may be classed into two divisions as to service, for exhausting purposes or suction service, and for blowing or pressure service. Fans of the suction type for suction or exhausting service may be for high or low suction pressures, while fans of the pressure type may be for high or low discharge pressures. The volume of suction or discharge is dependent upon the size, type, speed and pressure. It is common to hear of low pressure, volume fans or blowers and of high pressure, small volume blowers, referring of course to large volumes and low pressures or to high pressures and small volumes. The probable reason for such statements is that for some services large volumes at low pressure may replace a smaller volume at a high pressure. Fans can be obtained for very low pressures, a fraction of an inch of water pressure up to pressures of 20 to 30 pounds in the case of multiple wheel turbo blowers covering volume ranges of less than 100 cfm. to 100,000 cfm. and up.

In requesting price data on a fan clear specifications forwarded to prospective vendors will save expense on their part and confusion on the part of the buyer. A clear specification will usually save delay in getting fan equipment ordered and on the job. When requesting quotations on fans there are certain operating characteristics that should be known before an intelligent selection of equipment is possible.

It is advisable to ask a vendor to quote on two or three units coming close to the desired specifications rather than hold him to exact specifications, particularly as to volume. A little flexibility in specifications permits the vendor to quote on equipment that will come sufficiently close to the requirements and he may be able to use a size smaller unit than would be used if specifications were extremely rigid. Some manufacturers build fans for a competitive market as well as quality fans for the market desiring serviceability and operating economy. Therefore the manufacturer should be encouraged to quote on a number of units if he sees fit.

Often the fan that is lowest in price, that is, in first cost is the most expensive unit; in fact, this is usually the case. Having the performance data specifications shown the fan costs may be combined with operating costs and the economies of purchase and operation for a basis of selection. One instance noted a fan that cost $750.00 required 4 K.W. more power to operate it than another that cost $1,000.00. Installation costs were the same in either case. As continuous 24 hour operation was maintained for 300 days out of the year and power cost $.01 per K.W.H. the extra annual operating cost of the cheaper fan amounted to (24 x 300 x $.04) or $288.00 per year. So at the end of the first year neglecting interest and additional carrying charges initial and extra operating cost would be (750 + 288.00)—$1,038.00 as against $1,000.00 for the high first cost fan. The second year of operation would pay all interest and depreciation

*Corning, N. Y.

charges over that for the low priced unit and pay a profit besides. Even wider power input ranges than those shown in the above example have been noted.

Preliminary comparisons of fan performance are best made on the basis of the number of feet of free air delivered per minute per HP or K.W. input to driving unit and in such comparisons the most efficient units may be selected. After the discharge per unit power input is determined, then prices may be consulted and the selection made on the basis of initial price plus power cost for the first year or the first two years depending upon the probable obselescence and investment carrying charges of the blower equipment. Without such study, many kilowatts may be needlessly wasted by selecting equipment on a first cost basis only, for fan efficiencies vary greatly. Experience has shown that fan manufacturers as a rule are quite reliable and their operating data can usually be relied upon.

One of the important points to consider in specifying fan equipment is to know and state correct specifications. If a higher pressure than necessary is specified, a power loss results. The same is true of volume specifications. Guesses of pressures and volumes required is an expensive practice. The pressures and volumes may be calculated in case that insufficient test or operating data is available. However, in many cases calculations are not easily made and operating data on similar installations is not available. In such cases engineers may be called in for conference and specifications set with their help. In other cases actual tests are necessary to determine volumes and pressures required to produce the desired result. Guesses must be avoided in any event.

Measurement of air flow from a fan is a relatively simple matter. Flow may be measured by means of a Pitot tube, or an aneometer if the velocity is low and there is an open discharge or inlet. Pitot tubes are sold by some manufacturers of fans. When air is flowing in a pipe or duct there is a certain static pressure or static suction. There is also a force or flow or velocity pressure. The two added together gives the total pressure. The pressure that is specified is the static pressure which is the bursting pressure. In case of a suction fan, static suction pressure as well as static discharge pressure are necessary specifications.

Measurement of volume in a duct is found by computation from Pitot tube readings by use of the formulae below:

No. 1. Velocity in ft. per minute equals V equals $4000\sqrt{h}$ for 60° air and a 14.7# barometer where h equals the average velocity pressure in h/in inches of water as read from the tube. (U tube.)

No. 2. Flow per minute equals F equals AV where, A equals area of duct in sq. ft. and V equals velocity from formula No. 1 in feet per minute.

If pressures are very high or very low or if temperatures are high or low, corrections are necessary to reduce the flow to terms of standard air at 60° F. and 14.7#. The corrections are made from the formula

$$\frac{P_1V_1}{F_1} = \frac{P_2V_2}{F_2}$$

Where P is pressure, V is volume of flow and T is the absolute temperature which is equal to the observed temperature in degrees farenheit plus 460.

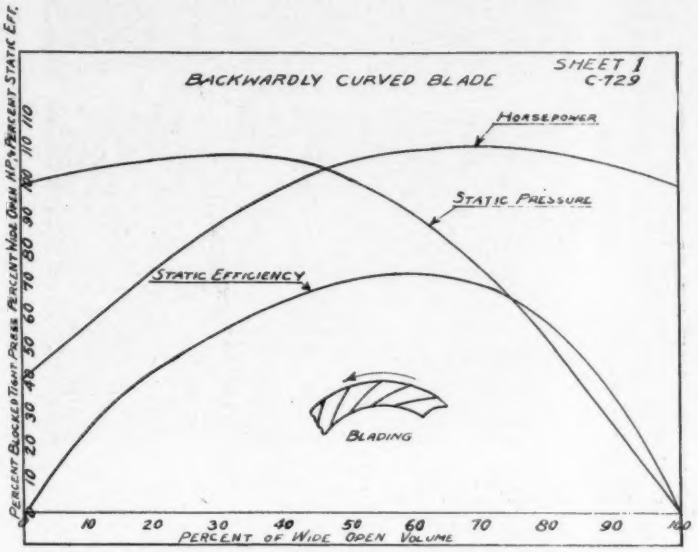
The corrections give more accurate characteristics if the temperature, pressure or barometer vary considerably from the standard of 14.7# barometer and 60° F. The corrections may be carried out one or all of them; actual conditions determine whether temperature, pressure or barometer corrections are required to reduce flow to normal conditions.

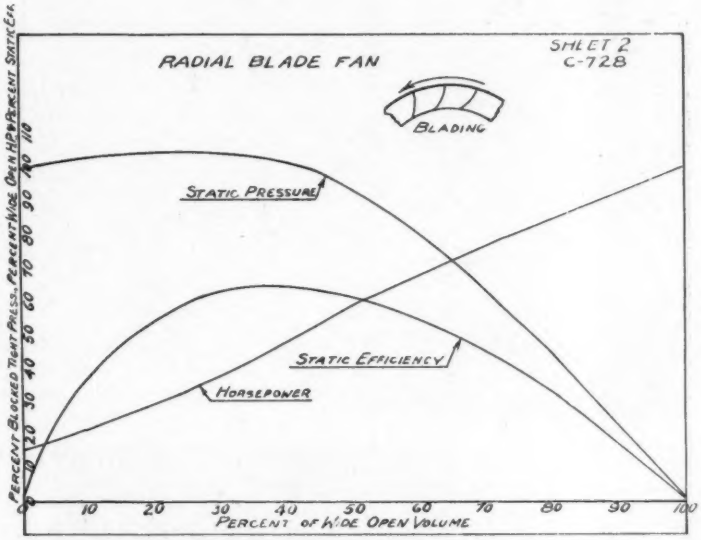
Fans are quite often purchased without the complete knowledge of their limitations. Some are designed so that the motors will become overloaded if the discharge pressure is lower (resulting in excess air flow through fan) than that for which the motor is selected. With such a unit a motor may be damaged in case the motor is selected close to the operating conditions specified. Other units are designed so that they have none-loading characteristics—in other words they will not require more than a certain horsepower regardless of the conditions of discharge. The radial or straight blade fans lie in the first class while blowers with backward curved blades are usually of the non-loading type. In case the volume and pressure specifications are somewhat uncertain the backward curved blade fan has a definite advantage. The characteristic curves of backward curved, radial and forward curved blades or impellers are shown respectively in Figures Nos. 1, 2, and 3 while it will be noted that the horsepower curve for the non-overloading type has a maximum and then drops off while the horsepower curve for the radial blade rises as the volume increases. (The curves shown were furnished through the courtesy of the B. O. Sturtevant Company.)

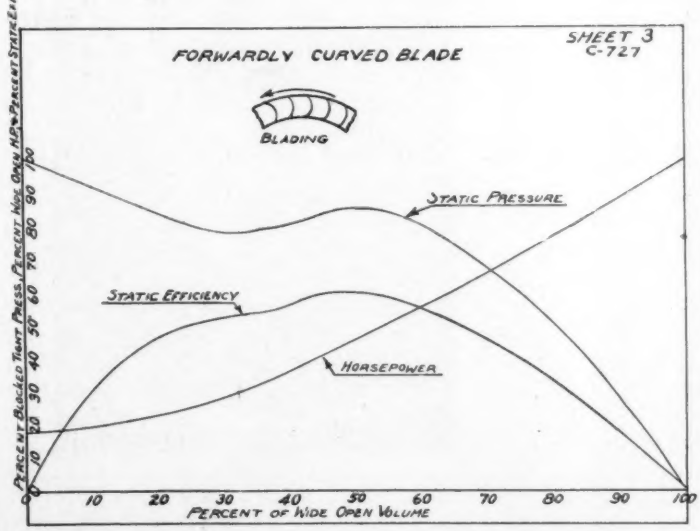
Fans of the non-overloading type are quite satisfactory for most services, however, if two or more fans operate on a single pipe system they are not as stable in operation as the straight blade type. This is because of the arched pressure volume curve in case of backward curved bladed fans, for there may be two points of operation at widely different volumes but with the same pressure.

The parallel operation of fans, that is, two or more on one duct system is not very satisfactory for fans are not positive in operation. In one particular case of two fans were operating on a single duct, first one would take the majority of air load and then the other would take the load. The load transferred from one to the other very rapidly and finally one motor kicked out on overload, and in a minute it was running backwards with air rushing out of its inlet. The fans were of the backward curved blade type. The same results were secured in a second attempt to get the units working together and after successive trials this scheme of operation was abandoned.

Frequently after a fan has been put in operation there is a feeling that it is not performing up to specifications. However, a check with a Pitot tube, a speed counter and a Watt-meter will soon show what is happening. It is not unusual to have a fan too small for the job for which it was purchased and that leads to the feeling that fan equipment is not fulfilling the specifications. Improper sizes of pipe at the fan outlet or restricted inlet may limit capacity. In one instance that was quite baffling, a high speed fan was not performing properly and after considerable delay the







rotation was checked and it was found that the fan had been running backward.

Increasing the pressure or resistance to flow in a piping system causes a constant speed fan to operate and give a lesser volume and conversely by decreasing the pressure the flow from the same fan is increased. If pressure and volume conditions must vary widely to produce proper results in an installation a fan with variable speed drive may prove to be very satisfactory. Closing a blast gate on a fan discharge is a permissable method of of controlling the pressure and volume if the fan is designed for maximum conditions. However, in many instances this is an uneconomical method of control especially if the operating range is wide. The pressure and volume limits demanded of a system must be given consideration when a fan is selected.

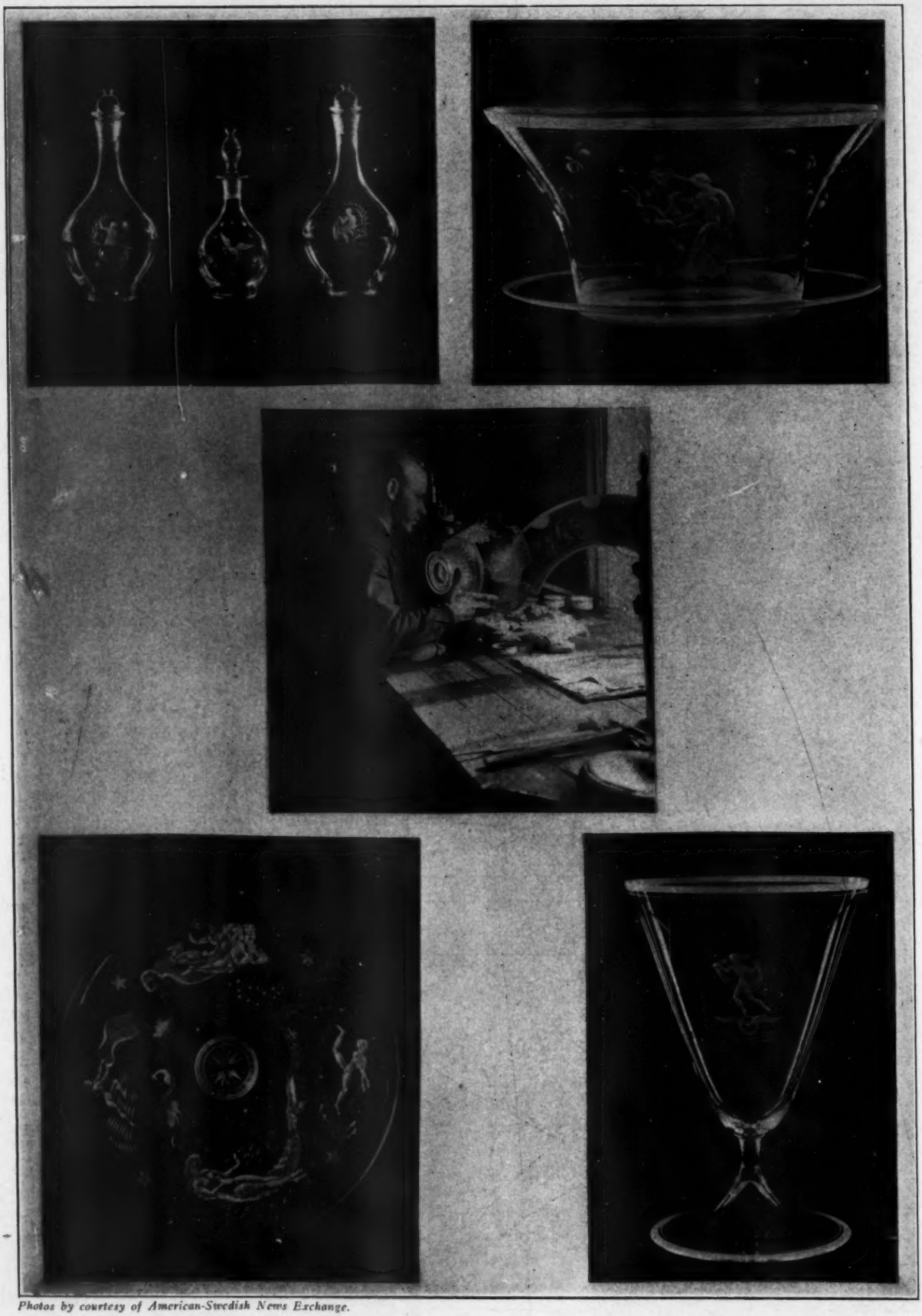
Certain laws exist in fan operation. They are of value when changes are to be made in the operating conditions. The laws usually to be found of use are:

1. The capacity of a given fan varies directly with the speed.
2. The pressure varies as the square of the speed.
3. The horsepower input varies as the cube of the speed.
4. Horsepower and pressure vary directly as the barometric pressure and inversely as the absolute temperature.

It will be seen from the above laws that if the speed of a fan is doubled the horsepower input will be increased in a larger proportion than the speed. Furthermore if speed is doubled the pressure may be more than doubled for the pressure increases in the ratio of the squares of the speeds. Care must be exercised to provide ample horsepower for a fan that is increased in speed while if the speed is decreased pressure and volume reductions should be given careful consideration.

During the past few years considerable improvement has been made in fan equipment. Occasionally an old type fan may be profitably replaced by a new unit even if the old fan is in good repair. A check may be made of the horsepower required by the old unit for the volume and pressure compared with the characteristics of a new fan. The operating economics may be developed and a decision made regarding the installation.

In the glass industry today fans are probably the least appreciated piece of equipment and yet one of the most useful. Often insufficient consideration is given to specification and purchase of fans and often too little attention is given them after they are in operation. A fan must fit the job or else it will operate inefficiently or it may give only partial satisfaction in the performance of its duty. Care in selection leads to lasting economy and satisfaction.



Photos by courtesy of American-Swedish News Exchange.

ORREFORS GLASS—SWEDEN. *Upper Left*: ENGRAVED PERFUMES CRYSTAL. BY HALD. ORREFORS. *Upper Right*: BOWL. ENGRAVED CRYSTAL, DESIGN BY HALD. *Lower Left*: "ROSE OF THE FOUR WINDS." MODERN SWEDISH GLASS ENGRAVING, DESIGNED BY THE SWEDISH ARTIST, EDWARD HALD, AND MADE BY THE ORREFORS GLASS WORKS IN SMAALAND, SOUTHERN SWEDEN. *Lower Right*: ORREFORS TUMBLER.

Alfred's New College

THE New York State College of Ceramics at Alfred has been completed some little time now, and on June 12 received its ceremonial opening, when the governor of the State pilgrimaged from Albany to the hills of Alfred to turn over the keys to President Davis.

The occasion attracted a goodly concourse, and by a fortunate circumstance, the day was ideal in the matter of the weather, coming just between the insufferable heat of the 11th and the frigid temperature of the 13th and 14th.

SOME WELL KNOWN VISITORS

R. M. Campbell, Trenton Potteries, Trenton, N. J.; G. E. Crawford, Eljer Company, Kittanning, Penna.; F. P. Hall, Onondaga Pottery Company, Syracuse, N. Y.; R. J. Clark, Dayton, O.; C. W. Parmelee, University of Illinois, Urbana, Ill.; A. V. Bleininger, Homer-Laughlin China Co., Newell, West Va.; G. A. Bole, Ohio State University, Columbus, O.; Frederick Heath, Jr., Columbus, O.; J. C. Hostetter, Corning Glass Works, Corning, N. Y.; N. W. Taylor, Penn. State College, State College, Pa.; M. G. Babcock, Pittsburgh Plate Glass Co., Pittsburgh, Pa.; F. W. Preston, Butler, Pa.; R. F. Sherwood, Smith and Stone, Ltd., Georgetown, Ontario.

The audience gathered in Alumni Hall, and at 10:30 the animals came in two by two, in mortarboards and gowns, to the strains of the Coronation March. A little military drill would have done them good, or alternatively the band might have played a lullaby.

Dr. Binns, the recently retired Director of the State School of Ceramics, pronounced the "Invocation," and did it clearly and well, and President Davis, himself retiring from the presidency of the University, then greeted the delegates.

Mr. Getman, Chief of the Education Bureau, made a very formal speech of greeting, and Dean Holmes, the new head of the College, followed with his "Introductory Remarks." In this he struck out on lines of his own, and delivered his speech without recourse to more than occasional notes. This was much better than most of the delegates succeeded in doing.

Dr. Hostetter, President of the American Ceramic Society, then presented an illuminated scroll to Dr. Davis, approving, in the name of the Society, the thirty-three years of Dr. Davis' presidency, and of his efforts to establish first a Ceramic School, and now a School of Glass Technology: and Dr. Bole, on behalf of the Fellows, continued the same line of thought.

About this time a cablegram arrived from Professor W. E. S. Turner of Sheffield, England, to Dean Holmes and Dr. Scholes, congratulating them on the occasion. It was read to the audience by President Davis.

"I rejoice with you on opening new building and particularly on leading the way in U. S. A., in providing systematic courses in Glass Technology. May your work prosper.

TURNER, Sheffield, England."

Professor Parmelee, of the University of Illinois, promised that Illinois would do better than Alfred, if it could, and hoped the contest would be a hot one.

The Hon. J. J. Merrill, State Tax Commissioner, gave his benediction to the project, and Mr. Bleininger of East Liverpool then started in to give the Ceramic Industries the "once-over." His method of approach was unusual and interesting: he compared the apparent limitations of the metal industries with the seemingly inexhaustible resources of the non-metallic ones with great effect. While the fuel industries produced a greater value of annual income than the metal and non-metallic ones combined, the last was slightly greater in volume (value) than the metal group, and was growing faster.

After a rather weak attack on the iniquities of foreign competition, Mr. Bleininger then examined the relative scope of the various branches of the ceramic industries, a matter in which he seemed more at home, and was giving a very interesting account of them when the broadcasting officials began to get agitated, as Governor Lehman was wanted on the air.

(*Continued on page* 81)

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The Meaning of the Word "Violet" Among Glass Technologists

"The Rose is red—
My nose is too:
The Violet's blue—
And so are you:
—*Little Brown Jug*

THERE seems to be a tendency, and to me it has seemed a latter-day tendency more particularly, to use the word "violet" as synonymous with purple.

Thus we find deep manganese glasses referred to as "violet" in literature, which perfectly competent men have described, when I placed them in their hands, as "wine-red." The glasses were manifestly "purple," in the sense that they transmitted fairly well the extreme violet and the deep red, absorbing almost completely the bright parts of the spectrum, green, yellow, and orange.

Originally violet was not a color, but a flower. The European violet—the kind the poets sing about—is a shy little flower and grows more particularly under the hawthorn hedges among the fallen leaves. It is famous primarily for its scent secondary for its habit of blooming out of sight beneath a fallen leaf, and thirdly for having given its name to the extreme blue end of the spectrum.

The color differs somewhat from the American wild violet, which also is scentless, and attracts insects by blooming in the open. It must, I think, be confessed however, that the color of the European violet is not a spectral color; it is faintly purple, but a very blue variety of purple. After a few drinks of old world ale, the poet is prepared to believe, and therefor to aver, that "the violet's blue." And he is not far out.

The term "purple" originally meant a much redder color than "violet." Red, tinged with blue, is apparently the original significance of "purple." Blue, faintly tinged with red, is the original significance of "violet."

The term "pink" in the first instance referred to the flowers we call "pinks" (Dianthus), and possibly referred to shape rather than color. (See the dictionary.) So far as color is concerned, "pink" is the best used to denote a very unsaturated crimson, that is, crimson with a lot of white mixed in. It is, however, apparently used to mean unsaturated purple. This does not seem to me very satisfactory.

Color terminology is in a chaos anyway, but glass men will need to agree a bit better on their descriptions. "Violet" at least should be restricted to strictly blue colors. If used to mean a purple with as much red as blue in it, then "ultra-violet" would logically include the infra-red.

"Purple" standing alone should mean a mixture of red and blue in equal proportions. We may speak of a "blue-purple" in preference to a "violet"; and of a "red-purple."

If a glass color is purple, it will be much bluer by daylight and much redder by ordinary artificial lights. A tungsten lamp seen through a purple glass will be red. Seen through a true violet glass, it will be simply faint, but blue.—F. W. P.

Alfred's New College

(*Continued from page 79*)

Accordingly, the Governor was introduced to the central microphone and made an excellent speech, partly on the prospects at Alfred, and partly an appeal to the graduating class thereof to take an active interest in politics, especially local politics. It was impossible, he said, to give people good government, unless they were interested, and actively interested, in getting good government. An apathetic people could not be well governed. The Governor's talk, throughout, was clear in thought, and delivered in a firm and pleasing voice.

Dean Holmes proposed that the Governor be made a

DR. J. C. HOSTETTER, PRES. AMERICAN CERAMIC SOCIETY

Doctor of Laws of Alfred University, and Principal Davis, nodding his head approvingly, thought it an excellent idea. So with a flowery speech, he declared him a Doctor of Laws, honoris causa; and two young professors stole up behind him and lassoed him with a purple hood, while President Davis presented him with a diploma.

Professor Scholes then harangued the microphone, to the effect that Mr. Bleininger also deserved a degree, and again Dr. Davis nodded vigorously, and declared that he made him a Doctor of Science, honoris causa, with all the rights and privileges attaching thereto. But Mr. Bleininger was not so easily lassoed as the Governor.

The Alma Mater was next sung. It didn't sound bad, but probably Alma Maters in general are too sentimental to be in good accord with English-speaking traditions. They seem more appropriate to the Latin races.

President Davis now pronounced the benediction, in strikingly unconventional language, and the capped and gowned procession rolled slowly out of the building.

An excellent meal was served in the "Brick", and the delegates then inspected the New College Building. The Governor had to depart hurriedly for Albany, but the President and Mrs. Davis held a reception at the Social Hall. We hope for great things from the New College.—

F. W. P.

Explanatory Remarks By Dean M. E. Holmes

I should like to call attention to the background of these dedication ceremonies which our friends have made it possible for us to arrange for today.

The New York State College of Ceramics recently elevated to that status from the status of a school, is the only institution in New York devoted to higher education in ceramics. For the current year its enrollment is 247, this figure representing a 40% increase over that of the preceding year. There is a staff of twelve instructors, each a specialist in his line of work. The College is organized on the basis of three departments, that of General Technology and Engineering, Glass Technology and Ceramic Art. The courses of study embrace all fields of the ceramic industries in their three essential aspects of technology, engineering and art. The plant now consists of three buildings, including the new one to be dedicated today, and affords 40,000 square feet of floor space devoted to lecture rooms and laboratories. $40,000 worth of new and up to date equipment was installed in this new building the past year and $15,000 worth will be installed the coming year. This large expansion program of the past year has more than doubled the size of the plant and the equipment and has materially relieved the serious restrictions that have prevailed in the past. That such restrictions were severe is indicated by the large increase in enrollment the past year. However, it might be worth while to note that we are again confronted with the necessity of restricting enrollment.

My purpose in mentioning these facts is to bring out the contrast of the present status of the institution with the conditions that prevailed 33 years ago when the Alfred pioneers established this school of ceramics. $20,000 was provided in that year to construct the building, equip it to provide for maintainance and pay salaries. The student body was negligible. Although Ohio State University had started the movement a short time before, ceramic education was as yet an unknown quantity, much less being established and even the ceramic industries doubted the need of it. It took vision to see the widespread and essential place that ceramic education was destined to hold in the educational system of the entire country, and particularly its possibilities at Alfred. It took courage to launch the venture and it took genius to build it up to the present status which I have just described. With Ohio State University, this institution has blazed the trail of ceramic education and at Alfred University it has culminated in the present status of the New York State College of Ceramics.

The most interesting sidelight of this background of today's ceremonies is that this entire third of a century of growth and development at this institution has been under

the continuous executive direction of one president and under the administration of one director. This record is unique in the annals of ceramic education and it may be observed that in the recent establishment of the glass technology department, the first in America, we have evidence of that same courage and vision that gave birth to the institution 33 years ago. It is most fitting that the dedication of the new building should come at just the time that our distinguished president must lay down his duties as executive head of this institution, and so soon after the similar retirement of my honored predecessor, the director emeritus. The

CHEMISTRY LABORATORY, NEW CERAMICS BUILDING ALFRED, N. Y. DEDICATED JUNE 12, 1933.

building may well serve as a monument to their great careers. As this building may serve as such a monument so may the busts of the President and Director which we have recently placed in the Assembly Room of the new ceramic building serve as symbols of the admiration and love for them by us who are to carry on and they shall be a constant source of inspiration to us in the years to come. The making of these busts was not a commercial proposition. We did not send out any order to a commercial sculptor. Instead they were modelled by one of us, Miss Elsie Binns, and they are not made of bronze, but of basic ceramic material, enduring clay. I should like to invite your particular attention to them this afternoon when you visit the ceramic building.

I was instructed to devote my talk to the aims and policies of the New York State College of Ceramics and now I have taken up all my time in presenting these side lights to the dedication ceremonies so I must let it suffice to state that the aims and policies of the College of Ceramics shall be those of the past modified only to the extent that new conditions demand and enlarged appropriations permit.

The policies include the development of effective contact with the industries, emphasis on the basic scientific work and the heavy applied engineering work and the direction of the art work to the industrial problems. The policies include also a desire to grow better rather than larger.

The incoming president of the New York College of Ceramics is Paul E. Titsworth of Chestertown, Maryland.

Men Who Attended the Dedication

M. G. Babcock, Pittsburgh Plate Glass Co., Pittsburgh, Penna.; G. Baer, State College, Penna.; Clinton Baldwin, Lakemont, N. Y.; Bailey, J. (Consulting Glass Technologist), Hamburg, N. Y.; A. V. Bleininger, Homer-Laughlin China Co., Newell, West Va.; George A. Bole, Columbus, Ohio; John Call, Buffalo Pottery, Buffalo, N. Y.; Robert M. Campbell, Trenton Potteries, Trenton, N. J.; Wm. Cannon, Onondaga Pottery Co., Syracuse, N. Y.; R. J. Clark, Dayton, Ohio; Guy Cowan, Onondaga Pottery Co., Syracuse, N. Y.; George Crawford, Eljer Company, Kittaning, Penna.; Eugene J. Eagle, Vitro Mfg. Co., Pittsburgh, Penna.; M. C Gregory, Corning Terra Cotta Co., Corning, N. Y.; Milton Groves, Olean Tile Company, Olean, N. Y.; F. P. Hall, Onondaga Pottery Co., Syracuse, N. Y.; Fred Heath, Columbus, Ohio.

J. C. Hostetter, Corning Glass Co., Corning, N. Y.; Rudolph Lapp, Lapp Indusltor Works, Le Roy, N. Y.; Henry Marley, University of Cincinnati, Cincinnati, Ohio;

NEW BUILDING, NEW YORK STATE COLLEGE OF CERAMICS, ALFRED UNIVERSITY, ALFRED, N. Y.

T. W. Place, Mount Clemons Pottery, Mount Clemons, Mich.; Remington Murphy, Corning Terra Cotta Co., Corning, N. Y.; C. W. Parmelee, University of Illinois, Nobana, Illinois; Marvin Pond, Olean Tile Company, Olean, N. Y.; Gordon D. Phillips, Olean Tile Company, Olean, N. Y.; C. C. Purdy, American Ceramic Society, Columbus, Ohio; F. W. Preston, Glass Technologist, Butler, Penna.; F. H. Riddle, Champion Spark Plug Co., Detroit, Mich.; Edward W. Schramm, Onondaga Pottery Co., Syracuse, N. Y.; Robert F. Sherwood, Smith and Stone Ltd., Georgetown, Ontario; Kenneth Stettinius, Lapp Insulator Co., LeRoy, N. Y.; N. W. Taylor, State College, Penna.; Herman Vielweg, Rutgers University, New Brunswick, N. J.; A. W. Whitford, Fiske Brick and Granule Co., Watsontown, Penna.

Determination of Soda in Glasses Containing Relatively Large Amounts of Potash

A modification of the determination of soda by precipitation as sodium zinc uranyl acetate was reported by Glaze in the Journal of the American Ceramic Society, volume 14,

no. 6, 1931, page 450. The presence of large amounts of potash interfere with soda determination by this method. It has been demonstrated recently that the excess of potash can be removed as perchlorate and the soda determined in the resulting solution.

In the previous work the perchlorates were decomposed before the precipitation of the soda, but it is now evident that it is only necessary to remove the excess perchloric acid by fuming, and the decomposition of the perchlorates is not essential. Consequently the acid-free sodium and potassium perchlorates are transferred to a weighing bottle, diluted somewhat, and as soon as the insoluble potassium perchlorate has settled out, a weighed portion of the clear supernatant solution is taken for the soda determination. The potash is determined by difference through the combined weights of the sodium and potassium fluosilicates.

Glasses containing from 5 to 20 percent soda and from 5 to 30 percent potash, analyzed under varying conditions, gave the following percentages of soda: 5.12, 5.12; 5.07, 5.14; 12.55, 12,57, 19.79, 19.78.—W. P.

LE TRAVAIL ET LE FACONNAGE DECORATIF DU VERRE

(Manufacture and Decorating of Glasswares)

By Jaques Wolf. M. L'Edition Universelle, S. A. Brussels. 1932 p. 411.

This book falls naturally, and in fact is actually divided, into two parts, the first dealing with the general properties of glassware, its history and manufacture, and the second dealing with decorating processes. The second part is four or five times as long as the first, and is clearly the part in which the author is interested.

The first part is sketchy. A few words are said on many subjects; in eighty pages an attempt is made to outline the chemistry of glasses—including colored or colorless, transparent and opalescent—, the physical characteristics of glasses, and the methods of manufacture not simply of artistic glassware, but of window and plate glass, and so on. This part of the book is impossibly compressed and might perhaps have been omitted without harm. The illustrations are in some cases misleading, and the analyses quoted, while perhaps correct so far as they go, are not necessarily final or typical.

This section of the book gets off on the wrong foot by stating that glass is a *salt* (the italics are Mr. Wolf's). This statement is so palpably false that it shakes our confidence in the author from the start. Again on page 32, we are told that the alkaline earths include the oxides of aluminum and iron, which is not ordinarily thought to be the case. The connection between strains set up in annealing and the phenomena of devitrification outlined at the top of page 39 is rather far fetched. The devitrification range and the range in which strains can be developed are normally far apart. It appears at the foot of page 42 and the top of page 43 that the author considers ferric oxide more obstructive of heat radiation than ferrous oxide, and this is by no means the case. The statements are made however, in such a form that perhaps they are more apt to be misleading than deliberately untrue. The statements at the top of page 46 about devitrification are also of an exceedingly unsatisfactory character. We doubt very much whether fluoride opals are a result of the presence of minute bubbles in the glass. It seems to be the present belief that they are due to minute crystals of fluorides. The statement at the foot of page 57 about the composition of bottle glass, namely, that it is high in lime and alumina, is certainly not true of typical modern practice. There are a number of misprints in the analyses of glass given in this section. For instance, on page 60, the silica content of a French glass is given as 1.9% when it should be 71.9 and on page 62, Pyrex is said to contain 1.8% of boric acid when it should be 11.8. There are many other statements in this part of the book which are of suspicious character. We could very well wish that the author had not attempted to write this section.

The second part of the book is of more value, and an impressive list of methods of decorating glass is provided. It begins with a brief historic resume and then proceeds to discuss numerous processes in detail. We find an outline of coloring materials for transparent and opaque glasses, with frequent recipes: a discussion of cased or "flashed" glasses, millefiori and mosaic work: methods of decoration that depend on changes brought about in the surface layers of glass, or by painting on the surface: then follows an account of the etching of glass with hydrofluoric acid and numerous variants thereof. Again we investigate means of "cracking off" glass by heat or otherwise: the use of saws and drills, and of abrasives of all sorts, whether in ordinary grinding or in sand-blasting. The polishing of glass is touched on, and various methods of silvering and mirror making. The final chapter gives interesting details on the manufacture of lead-stripping for stained glass windows, and photographs of some recent windows.

Obviously, a review of so wide a treatise is impractical: the reviewer does not claim an adequate knowledge of so many branches of glassmaking. The style is everywhere clear, and the book eminently readable (for those with a working knowledge of French). At times, however, it appears that the author is himself straying outside his province and tackling too extensive an undertaking. We feel a little shaken, for instance, by the chemistry of page 198, where we read that hydrofluoric acid is made by adding a concentrated acid to fluorspar, setting free fluorine vapor, which instantly combines with the hydrogen *of the air* to form hydroflouric acid.—F. W. P.

Big Gain in Plate Glass Production

The total production of polished plate glass by the member companies of the Plate Glass Manufacturers of America, as reported by Secretary P. A. Hughes, for the month of May 1933 was 7,922,434 sq. ft., as compared to 4,679,776 sq. ft. produced by the same companies in the preceding month, April 1933, and 3,015,943 sq. ft. produced by the Association members in the corresponding month last year, May, 1932.

Current Prices of Glass-Making Materials

as of June 27, 1933.

Quotations furnished by various producers, manufacturers and dealers

Acid	Carlots	Less Carlots
Citric (dom.) lb.	...	.23
Hydrochloric (HCl) 20° tanks Per 100 lb.	...	1.10
Hydrofluoric (HF) 60% (lead carboy) lb.	...	.13½
52% and 48% lb.	.10	.10–.11½
Nitric (HNO_3) 38° carboy ext Per 100 lb.	5.50	...
Sulpnuric (H_2SO_4) 66° tank cars ton	15.50	...
Tartaric lb.	... Po. or Gr. / Cry.	.21 / .21½
Alcohol, denatured gal.	...	...
Aluminum hydrate ($Al(OH)_3$) lb.	.04–.04½	.05½–.06
Aluminum oxide (Al_2O_3) lb.	.07	.09
Ammonium bifluoride (NH_4FHF) lb.	...	.14¾
Ammonia water (NH_4OH) 29° drums lb.	...	.02¾
Antimony, metallic (Sb) lb.	.02½	.02¾
Antimony oxide (Sb_2O_3) lb.	0.7	.07½
Antimony sulphide (Sb_2S_3) lb.	...	.08½
Arsenic trioxide (As_2O_3) (dense white) 99% lb.	.04	.04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh ton	56.50	...
90% through 100 mesh ton	44.00	...
Barium hydrate ($Ba(OH)_2$) lb.	...	.05¼
Barium mixture, glassmaker's, f. o. b. St. Louis ton	25.00	...
Barium nitrate ($Ba(NO_3)_2$) lb.	...	.07¼
Barium selenite ($BaSeO_3$) lb.	...	...
Barium sulphate, in bags ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f.o.b. shipping point ton	15.00–16.00	18.00
Bone ash, carlots lb.	.03	.03
Borax ($Na_2B_4O_7 10H_2O$) lb.	...	...
Granulated In bags, lb.	.02	.02¼–.02½
Powdered In bags, lb.	.02¼	.02½–.02¾
Boric acid (H_3BO_3) In bags, lb.	.04¼	.04½–.04¾
Cadmium sulphide (CdS)—		
Red lb.	...	.60–.75
Orange lb.	...	.55–.65
Yellow lb.	...	1.30–1.50
Chromium oxide (Cr_2O_3) lb.	...	.18
Cobalt oxide (Co_2O_3)		
In bbls lb.	...	1.15
In 10 lb. tins lb.	...	1.25
Copper oxide		
Red (C_2O) lb.	...	.25
Black (CuO) lb.	...	.17–.19
Black prepared lb.	...	.22
Cryolite (Na_3AlF_6) Natural Greenland (Kryolith) lb.	.08½	.09
Synthetic (Artificial) lb.	...	.08
Epsom salts ($MgSO_4$) (imported) technical Per 100 lb.	...	1.50–1.75
Feldspar—		
40 mesh ton	9.50–11.00	...
20 mesh ton	9.50–11.00	...
Granular ton	9.50–11.50	...
Semi-granular ton	9.50–11.00	...
L. C. L., (Min. 2 tons) $2.00 per ton additional plus charge for bags		
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)		
Bulk, carloads, f.o.b. mines ton	30.00	...
In bags or barrels ton	34.00	39.00
Imported ton	27.00	29.00
Formaldehyde lb.	...	.07
Graphite (C) lb.	...	.04–.07
Iron oxide—		
Red (Fe_2O_3) lb.	...	.0425
Black (FeO) lb.	.04½	...
Kaolin (f.o.b. mine) ton	8.00–9.00	...
English, lump, f.o.b. New York ton	14.50–25.00	24.50–30.00

Kryolith (see Cryolite)	Carlots	Less Carlots
Lead chromate ($PbCrO_4$) lb.	...	.30
Lead oxide (Pb_3O_4) (red lead) lb.	.0370	.075
Litharge (PbO) lb.	.0570	.065
Lime—		
Hydrated ($Ca(OH)_2$) (in paper sacks) ton	9.00	...
Burnt (CaO) ground, in bulk ton	6.50	...
Burnt, ground, in paper sacks ton	8.50	...
Burnt, ground, in 280 lb. bbls Per bbl.	2.15	...
Limestone ($CaCO_3$)	1.50–2.50	...
Magnesia (MgO)—		
Calcined, heavy (in bbls.) lb.	.06	.07
light (in bbls.) lb.	...	.23
extra light (in bbls.) lb.	...	.37
Magnesium carbonate ($MgCO_3$) lb.	.06	.10
Manganese 85% (MnO_2) lb.	57.50	60.00
Nickel oxide (Ni_2O_3), black—		
for nickel content lb.	...	.35
Nickel monoxide (NiO), green—		
for nickel content lb.	...	35
Plaster of Paris, bags ton	31.00	23.00–.9.00
Potassium bichromate ($K_2Cr_2O_7$)—		
Crystals lb.	.07½	.08
Ground lb.	.08	.08½
Potassium carbonate—94-96% lb.	.0555	.0555
Calcined (K_2CO_3) 96-98% lb.	...	.06¾
Hydrated 80-85% lb.	...	.05¾
Potassium chromate (K_2CrO_4) lb.	...	25
Potassium hydrate (KOH) (caustic potash) lb.	.07½	.08
Potassium nitrate (KNO_3) (gran.) lb.	...	.03–.03¼
Potassium permanganate ($KMnO_4$) lb.	.16	.16½
Powdered blue lb.	...	.16½–.17
Rochelle salts, bbls lb.	...	.11½
Rouge lb.	...	...
Rutile (TiO_2) powdered, 95% lb.	.15–.20	.20–.25
Salt cake, glassmakers (Na_2SO_4) ton	18.00	...
Selenium (Se) lb.	...	1.70
Silver nitrate (AgNO) (100 oz.) per oz.	...	.20¼
Soda ash (Na_2CO_3) dense, 58%—		
Bulk, on contract Flat per 100 lb.	1.05	...
In barrels Per 100 lb.	1.38	1.90–2.13
In bags Per 100 lb.	1.17½	1.72½–1.92½
Spot orders .025 per 100 lbs. higher	...	...
Sodium bichromate ($Na_2Cr_2O_7$) lb.	.04½	.05
Sodium hydrate (NaOH) (caustic soda)		
Solid Per 100 lb.	2.50	...
Sodium nitrate ($NaNO_3$)—		
Refined (gran.) in bbls lb.	...	3.62
95 per cent Per 100 lb.	1.245–1.345	1.295–1.395
Sodium selenite (Na_2SeO_3) lb.	...	2.00
Sodium fluosilicate (Na_2SiF_6) lb.	.04½	.05–.06
Sodium uranate (Na_2UO_4) Yellow or Orange lb.	...	1.40–1.45
Sulphur (S)—		
Flowers, in bbls Per 100 lb.	3.45	3.70–4.05
Flowers, in bags Per 100 lb.	3.10	3.35–3.65
Flour, heavy, in bbls Per 100 lb.	2.85	3.20–3.45
Tin chloride ($SnCl_2$) (crystals) lb.	.27½	.28
Tin oxide (SnO_2) in bbls lb.	.28	.29½
Uranium oxide (UO_2) (black, 95% U_3O_8) 100 lb. lots. Black lb.	...	2.75
Yellow orange lb.	...	1.40
Zinc oxide (ZnO) lb.	.08½	.12
American process, Bags lb.	.05¼	.06
Zircon		
Granular (Milled .005-.02c higher)	.07	.67½–.08
Crude, Gran. (Milled .005-.02c higher)	.03½	.04–.05

Potash Development in Southeastern New Mexico*

By H. I. SMITH,† WASHINGTON, D. C.

(New York Meeting, February, 1933)

The recently developed potash industry in southeastern New Mexico, though based on a relatively new discovery, marks the latest and perhaps culminating phase of the effort to obtain a domestic source of potash that began with the leaching of wood ashes more than 300 years ago. In the search for mineral potash in America, the Geological Survey has played a conspicious part and has paved the way for much of the private activity that now bids fair to free the nation of foreign domination in supplying the nation's potash requirements.

HISTORICAL REVIEW

A pamphlet published by Thomas Stephen in 1753 pictures the industry in its early struggling condition.[1]

Just before the Civil War, a deposit of mineral potash had been found in Germany and its value as a fertilizer had been discovered. On this account and because the supply of wood ashes had decreased, the American potash industry gradually lost its importance. During the next 50 years, with European potash available with little effort and with satisfactory substitutes on the market for the manufacture of soap, the interest of the American people in American potash declined.

In 1926 Congress authorized the five-year drilling program by the Geological Survey and the Bureau of Mines already mentioned.—(abstract)

*Published by permission of the Director of the U. S. Geological Survey.
†Chief, Mining Division, U. S. Geological Survey.
1T. Stephen: The Rise and Fall of Pot-ash in America. London, 1758.

Hartford-Empire Files Two Patent Infringement Suits

On May 31, the Hartford-Empire Company filed two suits in the United States District Court at Pittsburgh against the Shawkee Manufacturing Company of Pittsburgh, the Glenshaw Glass Company of Glenshaw, Pa., McKee Glass Company of Jeanette, Pa., and George R. Haub, charging infringement of a considerable number of glass feeder patents of the Hartford-Empire Company.

One of the suits, which is entitled in Equity No. 2792, charges infringement of 14 patents. The other suit, Equity No. 2791, charges infringement of Peiler patent No. 1,655,391, which patent was sustained and held valid and infringed about a year ago by the United States Circuit Court of Appeals at Philadelphia.

The glass feeder charged to infringe in these suits is the "Shawkee" feeder, which is being advertised for sale by the Shawkee Manufacturing Company of Pittsburgh.

Readers Wants and Offers

Address answers to all "keyed" ads c|o The GLASS INDUSTRY, 102 Maiden Lane, New York

Practical Glass Chemist. Now employed, with fifteen years experience in laboratory and plant, desires position with progressive glass manufacturing firm. This chemist is fully qualified to produce flint, colored, and opal glasses in either pot or tank furnaces, and to assume full responsibility for the economical manufacture of commercial glasses. Address JU-1, c|o The GLASS INDUSTRY.

The Owens-Illinois Glass Company, Toledo, plan the construction of a large new warehouse at their Huntington, Va. plant.

The Glass Industry Classified Buyers' Guide

FOR FURTHER INFORMATION, SEE ALPHABETICAL DIRECTORY OF ADVERTISERS AND CONSULT ADVERTISEMENTS

ALUMINUM HYDRATE
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

ALUMINUM OXIDE
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

ALUMINUM SULPHATE
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

ANTIMONY OXIDE
Drakenfeld, B. F., & Co., Inc., New York.

ARSENIC
Drakenfeld, B. F., & Co., Inc., New York.

AUTOMATIC BOTTLE MACHINERY (See Glass Working Machinery)

AUTOMATIC CONVEYORS AND LEHR LOADERS
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Hartford-Empire Co., Hartford, Conn.

AUTOMATIC GLASS WORKING MACHINERY (See Glass Working Machinery)

AUTOMATIC TEMPERATURE CONTROL
Wilson-Maeulen Pyrometer Division, The Foxboro Co., Foxboro, Mass.

BATCH CARTS
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

BATCH HANDLING AND MIXING SYSTEMS
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

BLOWERS AND EXHAUSTERS
The Kirk & Blum Mfg. Co., Cincinnati, O.

BLOWER SYSTEMS
The Kirk & Blum Mfg. Co., Cincinnati, O.

BOND CLAY
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

BORAX
American Potash & Chemical Corp., New York.
Pacific Coast Borax Co., New York.

BORIC ACID
American Potash & Chemical Corp., New York.
Pacific Coast Borax Co., New York.

BOTTLE-MAKING MACHINERY (See Glass Working Machinery)

BRICK INSULATING
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

CADMIUM SULPHIDES
Drakenfeld, B. F., & Co., Inc., New York.

CASTINGS, GLASSHOUSE
Dixon, H. L., Co., Pittsburgh, Pa.

CEMENT, HIGH TEMPERATURE
Laclede-Christy Clay Products Co., St. Louis, Mo.

CHEMICALS, COLORS, MINERALS, ETC. GLASSMAKERS
American Potash & Chemical Corp., New York.
Drakenfeld, B. F., & Co., Inc., New York.
Pacific Coast Borax Co., New York.
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
Sharp-Schurtz Company, Lancaster, O.
Solvay Sales Corporation, Syracuse, N. Y.

CHEMISTS, CONSULTING
Bailey & Sharp Co., Inc., Hamburg, N. Y.
Preston, F. W., Natl. Bank Bldg., Butler, Pa.
Sharp-Schurtz Company, Lancaster, O.
Solvay Process Co., Syracuse, N. Y.

CHIMNEYS, FACTORY
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

CHROME OXIDE
Drakenfeld, B. F., & Co., Inc., New York.

CLAY For Glassmakers
(See also Bond, Clay, Fire and Furnace Clay)
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

CLAY POTS
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

COAL HANDLING AND STORAGE SYSTEMS
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

COBALT OXIDE
Drakenfeld, B. F., & Co., Inc., New York.

CONSULTANTS, GLASS CHEMISTS
Bailey & Sharp Co., Hamburg, N. Y.
Preston, F. W., Butler, Pa.
Sharp-Schurtz Company, Lancaster, O.

CONTRACTORS
Furnace Construction and Repairs
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Toledo Engineering Co., Inc., Toledo, O.

COOLING SYSTEMS
The Kirk & Blum Mfg. Co., Cincinnati, O.

COPPER OXIDE, BLACK
Drakenfeld, B. F., & Co., Inc., New York.

CRUSHERS & PULVERIZERS
(Cullet, Coal, etc.)
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

CRYOLITE
Natural Greenland
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

DAMPER, SAND
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

DECOLORIZERS
Drakenfeld, B. F., & Co., Inc., New York.
Sharp-Schurtz Company, Lancaster, O.

DECORATING MATERIALS AND COLORS
Drakenfeld, B. F., & Co., Inc., New York.

ELBOWS AND FITTINGS, SHEET METAL
The Kirk & Blum Mfg. Co., Cincinnati, O.

ENGINEERING SERVICE
Factory Buildings

Chimney and Power Plant
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

Fuel and Furnace
Amsler-Morton Company, The, Pittsburgh, Pa.
Bailey & Sharp Co., Hamburg, N. Y.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Hartford-Empire Co., Hartford, Conn.
Sharp-Schurtz Company, Lancaster, O.
Toledo Engineering Co., Inc., Toledo, O.

Glass Factory
Amsler-Morton Company, The, Pittsburgh, Pa.
Bailey & Sharp Co., Hamburg, N. Y.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Sharp-Schurtz Company, Lancaster, O.
Toledo Engineering Co., Inc., Toledo, O.

Mechanical
Bailey & Sharp Co., Hamburg, N. Y.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

Plate Glass Factory
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

Producer Gas
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Wellman Engineering Co., Cleveland, O.

FANS, EXHAUST
The Kirk & Blum Mfg. Co., Cincinnati, O.

FEEDERS, AUTOMATIC GLASS (See Glass Feeders)

FELDSPAR
Sharp-Schurtz Company, Lancaster, O.

FIRE BRICK (See also Refractories)
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Laclede-Christy Clay Products Co., St. Louis, Mo.

FIRE AND FURNACE CLAY
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

FLOATING AGITATORS
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

FOUNDERS, GLASSHOUSE CASTINGS
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

FURNACE ENGINEERS (See Engineering Service)

FURNACE INSULATION (See Insulating Brick)

FURNACE REPAIR MATERIALS
Amsler-Morton Company, The, Pittsburgh, Pa.
Corhart Refractories Co., Louisville, Ky.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

FURNACES
Annealing (See Lehrs)

Tank and Pot
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

Recuperative
Amsler-Morton Company, The, Pittsburgh, Pa.
Toledo Engineering Co., Inc., Toledo, O.

GAS BURNERS
Amsler-Morton Company, The, Pittsburgh, Pa.
Bailey & Sharp Co., Hamburg, N. Y.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Sharp-Schurtz Company, Lancaster, O.
Toledo Engineering Co., Inc., Toledo, O.

GAS MAINS, STEEL
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

GAS PRODUCERS (See Producer Gas Plants)

GLASS CONSULTANTS
Bailey & Sharp Co., Hamburg, N. Y.
Sharp-Schurtz Company, Lancaster, O.

GLASS FEEDERS, AUTOMATIC
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Hartford-Empire Co., Hartford, Conn.
Miller, Wm. J., Inc., Swissvale, Pa.

GLASSHOUSE CASTINGS (See Castings)

GLASSHOUSE MACHINERY AND EQUIPMENT (See also Glass Working Machinery)
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Hartford-Empire Co., Hartford, Conn.
Miller, Wm. J., Inc., Swissvale, Pa.

GLASSHOUSE TOOLS
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

GLASS PLANTS, COMPLETE INSTALLATION
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Hartford-Empire Co., Hartford, Conn.

GLASS WORKING MACHINERY
Automatic and Semi-Automatic Bottle Blowing, Electric Presses, Feeders, etc.
Bailey & Sharp Co., Hamburg, N. Y.
Hartford-Empire Co., Hartford, Conn.
Wm. J. Miller, Inc., Swissvale, Pa.

GLORY HOLES, PORTABLE
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

HEATING SYSTEMS, HOT BLAST
The Kirk & Blum Mfg. Co., Cincinnati, O.

INSULATING BRICK, FURNACE AND BOILER
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

INSULATION, HEAT
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

KETTLES (all kinds)
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

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LEHRS
Electric
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Hartford-Empire Co., Hartford, Conn.

"Fireless", Automatic
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

Muffle
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Toledo Engineering Co., Inc., Toledo, O.

LEPIDOLITE
Drakenfeld, B. F., & Co., Inc., New York.

MACHINE SHOP SERVICE
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

MANGANESE
Drakenfeld, B. F., & Co., Inc., New York.

MIXERS, BATCH (See Batch Handling Systems)

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Miller, Wm. J., Inc., Swissvale, Pa.
Toledo Mould Co., Factories Bldg., Toledo, O.

OPACIFIERS
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

POWDERED BLUE
Drakenfeld, B. F., & Co., Inc., New York.
Sharp-Schurtz Company, Lancaster, O.

POT CLAY
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

PRODUCER GAS PLANTS
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Wellman Engineering Co., Cleveland, O.

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Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Wilson-Maeulen Pyrometer Division, The Foxboro Co., Foxboro, Mass.

PYROMETER TUBES
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Wilson-Maeulen Pyrometer Division, The Foxboro Co., Foxboro, Mass.

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Amsler-Morton Company, The, Pittsburgh, Pa.
Corhart Refractories Co., Louisville, Ky.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

REVERSING VALVES, GAS AND AIR
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

SALT CAKE
Drakenfeld, B. F., & Co., Inc., New York.
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

SELENIUM
Drakenfeld, B. F., & Co., Inc., New York.

SHEET METAL WORK
The Kirk & Blum Mfg. Co., Cincinnati, O.

SODA ASH
Solvay Sales Corporation, Syracuse, N. Y.

SODIUM SELENITE
Drakenfeld, B. F., & Co., Inc., New York.

STORAGE BINS, RAW MATERIALS (See also Coal Handling and Storage Systems, and Batch Handling and Mixing Systems)
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

TANK BLOCKS
Amsler-Morton Company, The, Pittsburgh, Pa.
Corhart Refractories Co., Louisville, Ky.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

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Drakenfeld, B. F., & Co., Inc., New York.

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The Kirk & Blum Mfg. Co., Cincinnati, O.

WASTE HEAT RECLAIMING SYSTEMS
The Kirk & Blum Mfg. Co., Cincinnati, O.

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